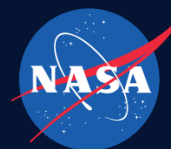


Advanced Control Method for Hypersonic Vehicles Element

Center Innovation Fund: AFRC CIF Program | Aeronautics Research Mission

Directorate (ARMD)



ABSTRACT

This research effort aims to develop software control algorithms that will correct for roll reversal before it happens. Roll reversal occurs when an aircraft is steered in one direction but rolls the opposite way due to aerodynamic conditions. The problem often compounds as a pilot attempts to correct for the motion by oversteering in the original direction, leading to uncontrollable roll. Unexpected yaw and subsequent roll reversal has caused the loss of high-speed, lifting body-like vehicles. The team has employed novel predictive software within adaptive controller technology to detect conditions likely to result in aircraft roll reversal and then automate compensating maneuvers to avoid catastrophic loss.

ANTICIPATED BENEFITS

To NASA funded missions:

- **Operates independently:** Unlike other standard control systems, this method allows for compensation and control of aircraft roll reversal without *a priori* knowledge of the dynamics.
- **Improves safety:** This technology is expected to prevent crashes that occur due to uncontrolled roll.
- **Increases envelope:** RCMR would enable planes to travel safely over a larger envelope.

To NASA unfunded & planned missions:

- **Operates independently:** Unlike other standard control systems, this method allows for compensation and control of aircraft roll reversal without *a priori* knowledge of the dynamics.
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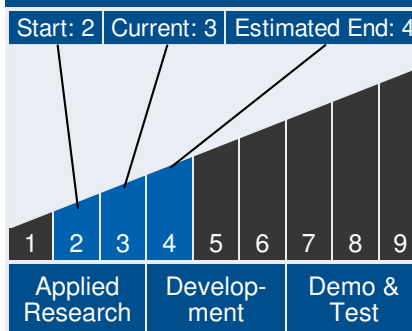


Vehicle Model

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Technology Maturity



Management Team

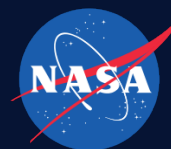
Principal Investigator:

- John Burken

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To other government agencies:

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Technology Areas

Modeling, Simulation, Information Technology and Processing (TA 11)

└ Computing (TA 11.1)

DETAILED DESCRIPTION

This research effort aims to develop software control algorithms that will correct for roll reversal before it happens. Roll reversal occurs when an aircraft is steered in one direction but rolls the opposite way due to aerodynamic conditions. The problem often compounds as a pilot attempts to correct for the motion by oversteering in the original direction, leading to uncontrollable roll. Unexpected yaw and subsequent roll reversal has caused the loss of high-speed, lifting body-like vehicles. The team has employed novel predictive software within adaptive controller technology to detect conditions likely to result in aircraft roll reversal and then automate compensating maneuvers to avoid catastrophic loss.

Work completed: University of Michigan's retrospective cost model refinement (RCMR) control algorithm has been integrated into a flight simulator and tested with prerecorded, open-source parameter data, which replicates the roll reversal anomaly.

Looking ahead: Next steps involve upgrading the RCMR code to account for a six-degree-of-simulation environment (forward/back, up/ down, left/right, pitch, yaw, and roll) with eventual application in a flight test environment.

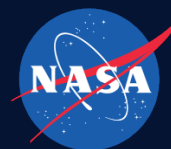
Partners: University of Michigan, other government research agencies, and aerospace firms.

Benefits

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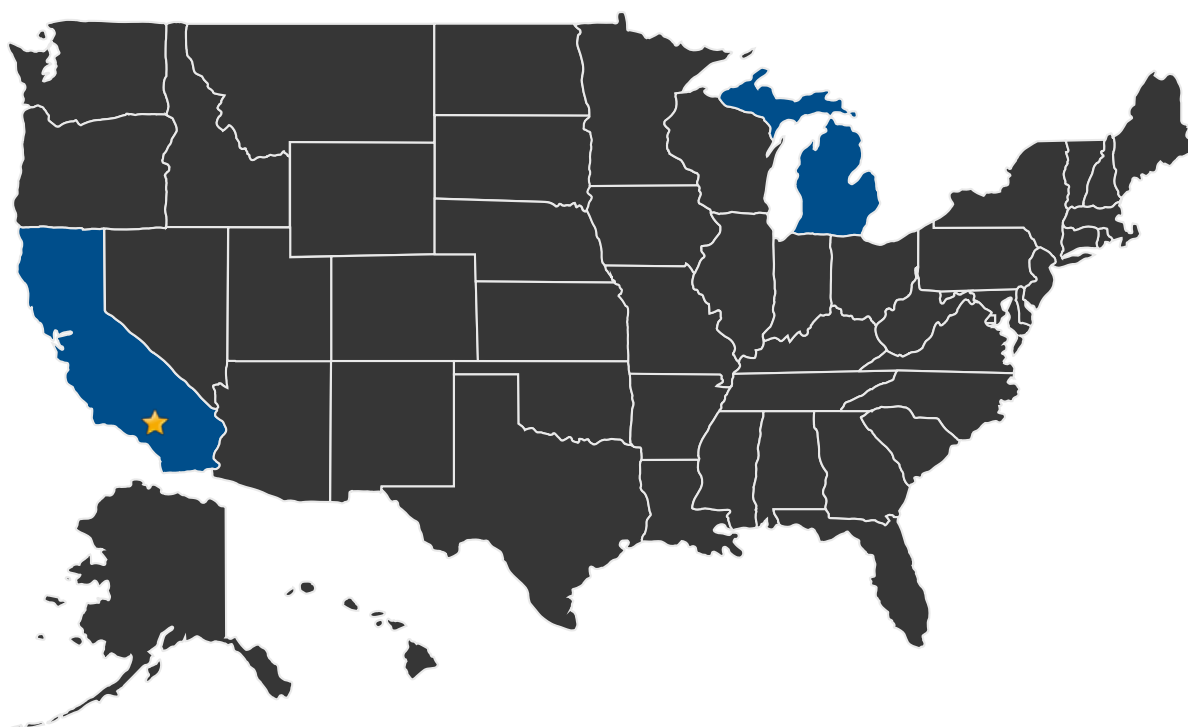


- **Operates independently:** Unlike other standard control systems, this method allows for compensation and control of aircraft roll reversal without *a priori* knowledge of the dynamics.
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Applications

- Hypersonic jets
- Lifting body-type space vehicles and reentry vehicles

U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States With Work

★ Lead Center:

Armstrong Flight Research Center

Other Organizations Performing Work:

- University of Michigan (Ann Arbor, MI)

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DETAILS FOR TECHNOLOGY 1

Technology Title

Advanced Control Method for Hypersonic Vehicles

Technology Description

This technology is categorized as complex electronics software for manned flight

This research effort aims to develop software control algorithms that will correct for roll reversal before it happens. Roll reversal occurs when an aircraft is steered in one direction but rolls the opposite way due to aerodynamic conditions. The problem often compounds as a pilot attempts to correct for the motion by over-steering in the original direction, leading to uncontrollable roll. Unexpected yaw and subsequent roll reversal has caused the loss of high-speed, lifting body-like vehicles. The team has employed novel predictive software within adaptive controller technology to detect conditions likely to result in aircraft roll reversal and then automate compensating maneuvers to avoid catastrophic loss.

Capabilities Provided

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Potential Applications

- Hypersonic jets
- Lifting body-type space vehicles and reentry vehicles